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Solar Mobile Charger

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***Abstract*—. Vedic literatures in India even state the use of flying machines which were powered using the sun. Coming 21st century, we have come a long way in developing solar cells which are the devices powering our future, converting sun's energy into electricity. This work is about using non conventional energy i.e. solar energy for mobile battery charging. Solar chargers are simple, portable and ready to use devices which can be used by anyone especially in remote areas. Solar panels don't supply regulated voltage while batteries need so for charging. Hence, an external adjustable voltage regulator is used to have the desired constant voltage.**

***Index Terms*— Amorphous silicon panel, crystalline solar panels, PIC Microcontroller 16F877A**

I. INTRODUCTION

Though the years, technology has allowed the cellular phone to shrink not only the size of the ICs, but also the batteries. However, as technology has advanced and made our phone smaller and easier to use we still have one of the original problem that we must plug the phones into the walls in order to recharge the battery. Most people accept the reality as there is no other option to this problem so they carry extra batteries with them. Every time it is not possible to charge mobile batteries everywhere at any time so we design this mobile charger from which we can charge the mobile battery anywhere at any time. In this project we are using the concept of energy harvesting by using solar energy for battery charging purpose. By using this we can charge our mobile battery in remote areas where there is a problem of electricity. Cost of this circuitry can be reduced to certain extend so that common man can easily purchase that and get benefit from that.

We will give the wide scope to this project by making certain modifications and we can use this charger for different handsets. Also modification to this project will be applying to any battery operated devices like laptop**.** This project can be divided into two main parts which are hardware and software development. The hardware development includes the solar panel connection, charging and control circuit and microcontroller. The software developments include the microcontroller programming.

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II. THEORETICAL BACKGROUND

A. How are Solar Panels Made

Solar energy has long been grabbing attention of the scientists and researchers as true alternate solution to fossil fuel energy. Noticing the enormous abundance of sunlight available to us as a blessing from our sun, it is not unusual to wish to tap this energy which has been there since the beginning of time and use it drive our engines and homes. However the solar energy even though it is available in abundance, the efforts to use this energy and transfer it into a usable form and drives our day to day appliances has been in vain. That is why solar energy has not become our prime source of our energy requirements. We are either relying on hydroelectric power which in turn causes environmental disaster or we burn coal or use nuclear energy to generate electricity. The main reason why we are not able to use the solar energy is our solar panels are not able to tap more than 20% of its energy. This results in huge investment cost but low return of investment. This makes the investment in solar energy unattractive and therefore is becoming less and less popular. However researchers all round the world have been able to develop solar panels that will tap this solar energy more efficiently. In order to understand how this is possible we need to understand how solar panels are made. There are two basic types of solar panels, first is the crystalline solar panels made of crystalline silicon and other is amorphous silicon panel which is made from amorphous silicon.

In order to make Crystalline solar panels, thin disks are cut from silicon in its crystalline form which are .8 cm thick. These disks are then subjected to a careful polishing and repairing process to ensure that no damage occurred during the cutting process has remained unattended. The thickness of these disks is so less that they appear to be wafer like disks which gives them the name "silicon wafers". Now for the main part of the process, adding the "dopants". Dopants are materials that are added to these silicon wafer disks so that they get electrically charged. The positive and the negative charges are added accordingly in these silicon disks and then are joined together so that electrons when subjected to sunlight can flow and conduct electricity. These disks now with the dopants in them are aligned horizontal and vertical manner to form a matrix pattern forming a solar panel. These solar panels are then covered with glass plate in order to protect them from any physical damage or scratches. The solar energy that our panels receive has two types of energy light and heat energy. These solar panels are then fitted with a special type of cement. This is conductive cement which transfers the thermal energy from the solar panels this preventing the solar

panels from the heat. This method of manufacturing solar panels is quite traditional and has been used by many solar panel manufacturers.

The amorphous silicon solar panels are made quite differently. The manufacturing process of amorphous silicon panels involves depositing silicon alloys in various layers. The solar cells made by this process are far more efficient and are capable of absorbing a wider range of solar spectrum. This type of panel manufacturing is now becoming very popular and is fast growing into an industry. The material cost of such solar panel is also cheap. The solar cells made from with this process have special ability to continue giving the same output even when the entire array of cells has come under shade. This prevents the circuit from being breaking and thus maintains the same energy output.

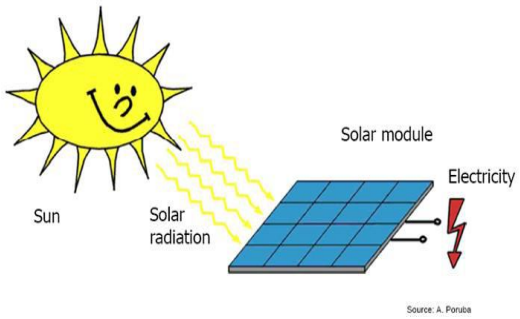
B. ***Solar Energy Compared to Other Alternative Energy Sources***

We have to switch to clean an energy source, which is for sure after realizing the consequences of using the fossil fuels and destroying the environment. The big question is how? Millions around the world depend on the vast energy reserves available deep down the earth. The reserves are depleting and will dry out soon. On the other hand the demand and the consumption rate are not going down. This is why we have to find out an energy source which will not only be free of pollution and eco friendly but also be able to produce enough energy to power our needs? So the question is whether there exist and energy source that can meet our needs or not. Let us discuss three alternative energy solutions that are available and find out whether that can be the one or not. These changes in the temperature and pressure occur due to the difference in the amounts of heat energy received by different areas from the sun depending on the earth's rotation. This energy in the form of wind can be converted into electrical or chemical energy, stored in the batteries. The devices used to tap this wind energy are windmills, as the wind blows the rotational energy of turbines is converted into electrical energy by generators. The process is clean, eco friendly and also renewable. One wind mill can produce enough energy to power a house. However the electrical energy that is produced from the turbines is not enough compared to the energy produced from the fossil fuels. The disadvantage is that it is costly and not completely renewable; therefore a better way needs to be discovered to produce energy completely clean and eco friendly. As the wind does not blow at a constant speed and there is no certainty about the wind direction and therefore the output is not efficient as it should be. Also, the wind mills subjected to a severe damage when struck by heavy rains and lightning storms can be subjected to heavy damage. The second is the biomass.

Biomass is a true renewable source of energy. This is because the substance used to produce energy is the excretal waste and remains of plants and animals, also human waste. Basically any organic material can produce bio energy. This therefore includes agricultural wastes, organic wastes, waste paper and waste from the food processing industries. Since this type of waste keeps getting produced everyday and in tons, there is no chance that the biomass energy such as bio fuel can get exhausted. The cons are similar to the wind power, very expensive therefore not enough energy output. Apart from these constraints, a bi product is created nitrogen oxide which is not good for the atmosphere if produced in large amounts.

Next is the solar energy, out of all the three energy sources this one is the most diversified form of renewable energy. Sun's heat energy can be used for various purposes which make it versatile. Through technological advancement, we have the capability to tap solar energy and produce energy and then store it. We also have developed devices that can harness the sun's heat energy for different purposes such as distilling water, boiling water for bathing or drinking etc. the cons is that the sunlight only remains for sometime during the day and therefore our solar panels should be efficient enough to absorb enough energy that can take us through the day. But as mentioned above efficient panels have been built and there is hope that we will be able to create solar panels powerful enough to absorb more energy and become self sufficient. Therefore solar energy seems to be the true alternative energy source which we can use it.

B. How electricity produces from solar panel



The principle used to generate electricity from the solar panels is the same as that used to generate electricity from the chemical reaction using a standard battery. The basic working of solar panels depends on the semi conductor property of silicon. The silicon is a unique substance that has revolutionized the way electronic appliances work. This property is used to generate electricity from the solar panels. In order to understand how solar panels work we need to understand how silicon works at an atomic level. Silicon in its pure form i.e. when all the impurities have been removed a silicon atom is bonded with another silicon atom. Since the valency of silicon atom is 8 which means that there are 8 electrons in its outermost orbit. However in its natural state there are only 4 electrons bounded in the outermost orbit. Hence these 4 electrons are able to bond with another 4 electrons with 4 silicon atoms around it. The 4 free electrons that can move around throughout the substance. During the absence of electric potential these free electrons tend to remain close to their parent atoms so that they are at minimum energy level. However when the electric potential is applied across the substance these free electrons receive energy and move direction of the potential difference applied thus producing electric current. However the current produced in a pure semiconductor is quite less

because these free electrons wants to remain at minimum energy level possible. Now let us take an example of a pure silicon semiconductor and introduce a small amount of phosphorus. Now this new atom has five electrons around it. When it bonds with other 4 silicon atoms, its fifth electron is free. But again during the absence of potential difference, the fifth electron is bonded with the phosphorus atom. In presence of potential, these free electrons can move in the direction of the potential difference applied hence generating electric current. This phosphorus atom is negatively charged this makes the silicon/phosphorus plate negatively charged. In the same way when another substance such as boron is introduced in a pure silicon plate, it becomes positively charged. This is because boron has valency 3 and there is one space left in the boron atom which is called "a hole". Since this plate hence needs an electron and hence it becomes positively charged, these two positive and negatively charged plates when combined together can now produce electricity. This is when the sun's energy comes into picture. The solar radiation coming from the sun is used as a trigger to initiate a flow of electric current from positive plate to the negative plate. Now what exactly in the sun's radiation causes the electrons to agitate? The substance is photon. When this photon falls on the negative plates of the solar panel it knocks off free electrons on the plate. As this electron is loosely attached to its parent atom is freed it can now move around the plate. However this electron is attracted by the positively charged plate and the electron is bounded again. In the same way when more photons knock off electrons, electricity is generated. The current produced by a single solar cell is very less. However when this current is drawn by the wires, it can power a small motor or other small electronic devices. Many solar cells when combined together can produce sufficient amount of electricity to power a house. However the main disadvantage of this technology is that manufacturing cost of these panels is very high, also you need large amount of solar panels if your energy requirement is very high. This is the reason why solar panels and electricity produced through them have a very high start up cost. The advantage is that when solar panel are installed they can produce electricity virtually free.

III. FRAME WORK OF PROJECT

A. Proposed Work

Fig 1.shows block diagram & overview of the project. There are three main input sources like AC input, input from solar panel and last one is storage battery. Here we are using PIC microcontroller 16F877A. There is a LCD display which shows all information related to battery. A buck converter was chosen because of its simplicity, efficiency and low heat Dissipation .The PIC microcontroller controls the buck converter through the use of hardware PWM Module and an external current sense resistor. The hardware PWM and current sense resistor feedback are significant in providing an accurate and repeatable charge methodology

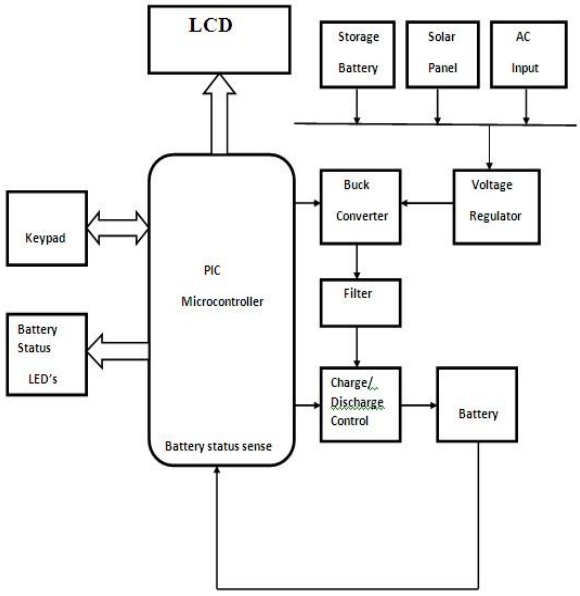


Fig 1: Block diagram

B. Source selection

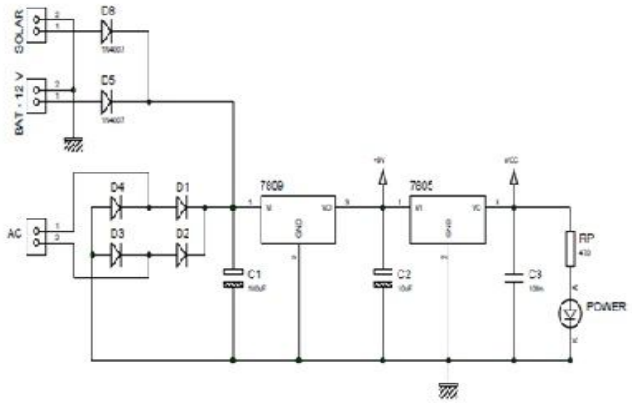


Fig 2: Source selection

Source selection is the main part of this project. There are three main input sources like input from solar panel, input from AC and last one is input from storage battery. In above figure diode D5 and diode D8 are act as protection diode. Diode D1, D2, D3 and D4 are act as bridge rectifier and used for the rectification of AC input voltage.

C. Voltage Regulator

Here in both 7809 and 7805 capacitors are used for to remove the ripples and act as filter capacitor.(To remove AC components) **.** ICs regulator is mainly used in the circuit to maintain the exact voltage which is followed by the power supply. A regulator is mainly employed with the capacitor connected in parallel to the input terminal and the output terminal of the IC regulator. For the checking of

gigantic alterations in the input as well as in the output filter, capacitors are used. While the bypass capacitors are used to check the small period spikes on the input and output level. Bypass capacitors are mainly of small values that are used to bypass the small period pulses straightly into the Earth.

D. PIC Microcontroller 16F877A

Here we are using PIC 16F877A.Battery type is selected by switch, PIC tells charging chip which battery has been selected. The PIC microcontroller controls the buck converter through the use of hardware PWM Module and an external current sense resistor. The hardware PWM and current sense resistor feedback are significant in providing an accurate and repeatable charge methodology.

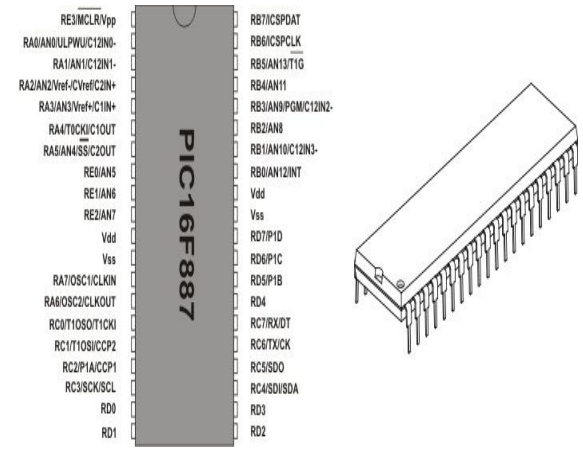


Fig 3: Pinout diagram of PIC 16F877A

*E. **Filter***

The filter circuit is an optional and intended to provide additional ripple suppression at the buck Converter output stage. The output of buck converter is applied to filter and the output of filter is applied to charge discharge control circuit.

F. Battery status LED's and Keypad

Here we are using some indications in our circuit. Green LED on for fully charge battery when battery reaches the voltage approx. 4.5 volt. Red LED on for discharge battery.LCD display for all status of information. The battery status can be displayed using status LED's. If any set point needs to be changed keypad can be used.

G. Buck converter

The most critical parameter in charging batteries is the control of the power source. Whether Current or voltage charging is being used (we use constant current method), control of the Power source is imperative to proper battery charging. The power source for our system is a Buck converter. A buck converter is chosen because of its simplicity, efficiency and low heat Dissipation .The PIC microcontroller controls the buck converter through the use of hardware PWM Module and an external current sense resistor. The hardware PWM and current sense resistor feedback are significant in providing an accurate and repeatable charge methodology.

IV. OVERVOLTAGE PROTECTION WITH AUTO CUT-OFF

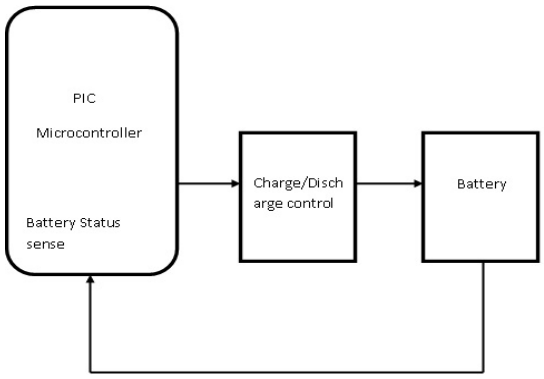


Fig 4: Overvoltage protection with auto cut-off block diagram

Over voltage protection circuit includes charge discharge control unit, battery, and PIC microcontroller for the battery status sense. The PIC performs battery voltage readings during the rest period of the charge cycle, this status information reading is used to protect the battery from overcharging. By using over voltage protection circuit we can protect our battery from over charge. Charge discharge control circuit contains two-way Switch. It gets active when voltage exceeds above threshold voltage level. By using this unit we can apply proper battery voltage to our cell phone battery.

V. APPLICATIONS

- For low-power portable electronics, like calculators or small fans, a photovoltaic array may be a reasonable energy source rather than a battery.
- In other situations, such as solar battery chargers, watches, and flashlights the photovoltaic array is used to generate electricity that is stored in batteries for later use.
- By using over voltage protection circuit we can protect our battery from over charging. Charge discharge control circuit contain two-way Switch. It gets active when voltage exceeds above threshold voltage level.

VI. ADVANTAGES

- Cost Effective: Compared to the other mobile chargers, the solar chargers are cost effective as it absorbs power from the sun. It does not require electric power
- Versatile: It is also known to be versatile as it can be used for all types of mobile phones
- Uninterrupted Power Supply: One of the greatest advantages of solar mobile phone charger is that it can be used to charge mobiles even during power outages.
- Emergency Purposes: Another benefit is that it hardly requires any electrical outlet. It can therefore be used during emergencies and outdoor purposes.

- Compact Design: Solar mobile phone chargers are compact in size and easy to carry around.

VII. LIMITATIONS

- Quite expensive: One of the most important drawbacks is its price compared to the ordinary mobile phone chargers, it is quite expensive as it utilizes solar energy captivators.
- Charging time large: Another significant drawback is the time frame required by the chargers to charge mobile phones. It can take six to eight hours to charge mobile phones compared to the other.

VIII. CONCLUSION

Renewable energy is not a new concept, nevertheless at an exponential growing population, the development and improvement of them are essential to sustain world power hunger. In 2050 the population expectation on earth is about 9 billion people, where approximately 5 billion will use mobile phones. The application of renewable energy at portable devices starts to plays a significant role at global energy saving. Solar chargers are simple, portable and ready to use devices which can be used by anyone especially in remote areas.

XI. FUTURE SCOPE

Basically the solar mobile charger is designed for charging mobile battery. But in future, by making some modifications we can use this charger to charge batteries used in different portable devices like laptop, walky-talky, i-POD, digital camera etc.

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